



# Light Electric Vehicles for a Green Transport Transition

Regulatory Approaches, Managerial Challenges and Market Potentials in Germany and China

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### Registered offices:

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### Address GIZ in China:

Sunflower Tower, Room 1100 Maizidian St. 37, Chaoyang District,  
100125 Beijing, PR China

T +86 1085275180

F +86 1085275185

E [transition-china@giz.org](mailto:transition-china@giz.org), [giz-china@giz.de](mailto:giz-china@giz.de)

I [www.giz.de](http://www.giz.de)

I [www.transition-china.org/mobility/](http://www.transition-china.org/mobility/)

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### Responsible:

Alexander von Monschaw, GIZ in China

[alexander.monschaw@giz.de](mailto:alexander.monschaw@giz.de)

### Authors:

Tong Liu, GIZ in China

Prof. Dr.-Ing. Ralf Bogdanski, Nuremberg Institute of Technology

### Reviewed by:

Carolin Bernhard, GIZ in China

Dr. Ying Hui, Tongji University Shanghai

Prof. Dr.-Ing. Dennis Knese, Frankfurt University of Applied  
Sciences

### Layout and Editing:

Lena Marie Böhrk, GIZ in China

Quentin Radlwimmer, GIZ in China

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# I Executive Summary

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High levels of congestion and increasing population pressures in cities across the globe demand innovative and more sustainable mobility solutions to traffic bottlenecks. In recent years, a new range of electric micro vehicles has emerged to address some of these urban mobility needs and offer alternative modes of individual transportation: including all forms of individual transport below the category of cars, such relatively low-cost and agile vehicles turn into important drivers of an urban transport transition.

Meanwhile, both regulatory challenges and the lack of standardisation risk decelerating the electric micromobility adoption. Despite the rapid development of the sector and increasingly global operators, there is still no uniform set of definitions of different electric micro vehicles. This report aims to shed light on the technical regulatory and managerial mechanisms of electric micro vehicles in Germany and China. It follows a broad classification of vehicles into non-standardised Personal Light Electric Vehicles (PLEV), two-wheeled, three-wheeled and four-wheeled vehicles.

In Germany, the lack of regulation particularly for the smallest category of PLEV has been a crucial hurdle to their market entry for years. Concurrently, the ambiguous positioning of PLEV in Chinese traffic laws and lack of national standards have resulted in regulatory

loopholes and low-quality standards, which are slowly addressed by increasing technical standardisation and due diligence, common safety standards and tighter controls.

PLEV and electric bicycles enjoy a variety of privileges when using public roads in Germany: they do not require a driver license or registration and are not subject to helmet requirements. The relatively barrier-free acquisition and use of PLEV have therefore driven increasing consumer demand. However, compared to the more mature market of electric two-wheeled and three-wheeled electric vehicles in China, the German electric micro vehicle industry still depicts an infant industry with significant growth potential.

Yet, in order to incorporate electric micromobility in urban transition ventures, legal frameworks and traffic regulations in both China and Germany must better reflect and adjust to the usage of all new micro vehicle classes. Clear coordination of regulatory frameworks and managerial responsibilities on national and local levels, together with the standardisation of vehicle definitions, are key to ensure their smooth integration into existing and future urban traffic layouts.



## II Abbreviations

ABS	Anti-lock Brake System
BEV	Battery Electric Vehicle
BMVI	German Federal Ministry of Transport and Digital Infrastructure
eKFV	German Electric Micro Vehicle Ordinance
EmoG	German Electro Mobility Law
ESP	Electronic Stability Programme
EU	European Union
FLEV	Fast Light Electric Vehicle
LEV	Light Electric Vehicle
MIIT	Ministry of Industry and Information Technology
MPS	Ministry of Public Security
NEV	New Energy Vehicle
NBV	Neighbourhood Vehicle
PLEV	Personal Light Electric Vehicle
SLEV	Slow Light Electric Vehicle
StVZO	German Road Traffic Registration Ordinance



# 1 Introduction

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While more than a quarter of the world's population is already living in large cities with more than one million inhabitants, the acceleration of urbanisation worldwide poses key challenges to seamless urban transportation. Particularly peak traffic periods necessitate high operation capacity of both public and individual modes of transportation. And yet, looking at the average peak traffic speed in large cities worldwide, congestion and average speed levels of below 30 km/h inevitably have negative impacts on everyday commuting in private vehicles, public transportation as well as logistics processes.<sup>1</sup>

As an alternative to traditional motorised and non-motorised vehicles such as bicycles or rickshaws, which might not fit all topographies or climate conditions, a new range of electric micro vehicles has emerged to offer city dwellers ways out of some of the congestion and population pressures: higher average speeds, less waiting or parking time, lower total costs of ownership, and the avoidance of traffic jams. Simultaneously, electric micro vehicles produce zero local emissions and less noise at low pace levels. They take up less space in moving and stationary traffic, and offer various health-related benefits of physical activities outdoors.

Theoretically, electric micro vehicles could

cover the majority of passenger trips below a total distance of 20 km, which equals the average city single trip by car in China (one-way trip around 10 km in large cities).<sup>2</sup> Similarly, in Germany the average single trip, irrespective of vehicle type, amounts to 12 km, including a 25% share of distances below 2 km.<sup>3</sup> To actively boost the development of electric micromobility in increasingly congested cities, a number of stricter government traffic management measures has been recommended. These include measures such as banning cars from heavily congested or polluted areas, restricting the use of conventional motor vehicles on a time-sensitive basis, the levying of a city toll or reducing the public space available for and dedicated to individually used automobiles. In many German cities, environmental zones are already being designated, in which only motorised vehicles with certain exhaust emission standards are allowed to enter via an emission sticker system. In addition, there are specific municipal driving bans for older diesel vehicles.

In this context, new regulations and municipal transport planning need to consider a redistribution of urban space, not only to address the needs of new vehicle categories or shift-

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<sup>1</sup> INRIX. (2020). INRIX 2020 Global Traffic Scorecard. Retrieved from: <https://inrix.com/scorecard/>.

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<sup>2</sup> CAUPD 2021 Annual Commuting Monitoring Report for Major Cities in China- Retrieved from: <http://www.chinautc.com/upload/fckeditor/2021tongqinjiancebaogao.pdf>.

<sup>3</sup> Nobis, Claudia and Kuhnimhof, Tobias. (2018). Mobilität in Deutschland – MiD Ergebnisbericht. Bonn, Berlin, on behalf of BMVI. Retrieved from: [http://www.mobilitaet-in-deutschland.de/pdf/MiD2017\\_Ergebnisbericht.pdf](http://www.mobilitaet-in-deutschland.de/pdf/MiD2017_Ergebnisbericht.pdf).

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ting modal shares on roads, but also to meet the demand of ubiquitous logistics operators. Indeed, as current public transportation spaces are predominantly catering to the traditional automobile, bicycles and residents, conflicts with new electric micro vehicles may arise when new types of vehicles with different needs, speed limits, and driving or parking modes are introduced onto public roads, including bike lanes and sidewalks. These conflicts often revolve around infrastructure and the allocation and use of priority rules, regulatory frameworks, and safety issues. The lack of unified technical and managerial regulations, whether for priority rules, licensing issues, or liability determination and insurance claims in case of accidents, depict further obstacles to the integration of electric micro vehicles in urban transportation systems.

More concretely, varying use cases of electric micro vehicles, such as usage in shared fleets or private use, necessitate an adapted design of relevant regulations and consequently adequate consideration in urban planning. Here, key challenges relate to the allocation of urban space dedicated to moving and parking of individual and shared vehicles, as well as the spatial distribution of charging infrastructure, which might differ largely for different types and use cases.

Against this background, this report aims to analyse and compare the technical regulatory

and managerial mechanisms of electric micro vehicles in Germany and China, including all intermediate electric forms of individual transit below the category of cars or trucks. It illustrates the current challenges and opportunities of this new field of transportation, offers insights into technical standards, market developments and growth potential in both countries. A conclusive outlook provides comparative perspectives for stakeholders, as well as guidelines for further cooperation in the rapidly developing electric micromobility sector.



## 2 Overview of Technical Standards and Regulations

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Despite the rapid development of the electric micromobility sector and increasingly global operators, there is no uniform set of definitions of different electric micro vehicles recognised in both China and Germany. On the contrary, the two countries apply distinct nomenclatures for vehicle classes and their respective technical standards.

Electric micro vehicles, in this article also termed Light Electric Vehicles (LEV), can further be sub-categorised, for example, into Slow LEV (thereafter SLEV) and Fast LEV (thereafter FLEV), with distinct definitions and varying terminology by region and author. For instance, the term SLEV in Germany or Europe typically includes electric vehicles with speed limits of less than or equalling 45 km/h. In China, a similar speed limit for SLEV is commonly less than or equal to 50 km/h (see GB7258-2017; this includes only two-wheeled and three-wheeled, but not four-wheeled vehicles).

While the Chinese authorities do not explicitly recognise FLEV, the distinction between SLEV and FLEV is of high relevance in Germany, where there are major differences in the required driving license classes, registrations and inspections, as well as the right to use specific infrastructures such as cycling lanes. Aside from the distinction between different speeds, the German regulatory framework further distinguishes between unclassified and classified vehicles. Unclassified vehicles, which

include a range of Personal Light Electric Vehicles (PLEV) such as electric boards or e-balance-bikes, are driver license-free and mostly not subject to compulsory insurance. In contrast, classified vehicles require a driving license and are subject to compulsory insurance, albeit without registration and no obligation to undergo regular inspections.

A comparison between Chinese and German regulations reveals main differences at the administrative level, especially in the specific definitions of each vehicle class and different approaches to licensing and regulating vehicles. Traffic and transport regulations in Germany are mostly drafted at the national or supranational level. Regional and municipal authorities nonetheless retain certain legal competences to organise traffic layouts, for example regarding parking space statutes. In China, technical regulations are usually drafted by the central government at the national level. Provinces and cities, in consideration of local market conditions and distinct development stages, individually remain in charge of enrolling managerial regulations. While these local guidelines may never infringe on existing national law, they can bring positive effects of early, immediate, and widespread implementation of new types of vehicles in various regional contexts, even when no national managerial regulations have been drafted (yet).

## 2.1 Vehicle Classification in Germany

In Germany, the classification of transport modes and vehicles for individual transport is linked to the supranational law of the European Union (EU), which classifies each motorised vehicle. In this case, the vehicle class L is used to regulate light vehicles, ranging from L1e to

Germany					
	Regulatory Name	EU-Vehicle Class	Speed	Power	Regulations and Requirements
Two-wheeled	Pedelec	no	Pedal assist up to 25 km/h	250 W	No license, insurance or helmet needed. Allowed on bicycle track. Trailer allowed.
	S-pedelec	L1e-B	Pedal assist up to 45 km/h	500 W	AM driving licence, insurance and helmet needed. Not allowed on bicycle track.
	E-bike 20 (Powered cycle)	L1e-A	Motor assist up to 20 km/h	500 W	AM driving licence and insurance needed. Helmet not needed. Can be used on bicycle tracks out of town.
	E-bike 25 (Powered cycle)	L1e-A	Motor assist up to 25 km/h	1,000 W	AM driving licence, insurance and helmet needed. Not allowed on bicycle track.
	E-bike 45 (Two-wheeled moped)	L1e-B	Motor assist up to 45 km/h	4,000 W	AM driving licence, insurance and helmet needed. Not allowed on bicycle track.
	Two-wheeled motorcycle	L3e/L4e for vehicles with side-car)	> 45 km/h	11,000 W	A1, A2 or A driving licence needed. Sub-categorisation according to performance levels.
Three-wheeled	Three-wheeled moped	L2e	< 45 km/h	4,000 W	AM driving licence needed. Sub-categorisation according to passenger transport or utility purposes.
	Powered tricycle	L5e	> 45 km/h		A1, A or B driving licence needed.
Four-wheeled	Light quadricycles	L6e	< 45 km/h	4,000 - 6,000 W	AM driving licence needed. Subcategorisation according to performance levels, passenger transport or utility purposes.
	Heavy quadricycles	L7e	> 45 km/h	15,000 W	B driving licence needed. Subcategorisation according to performance levels, passenger transport or utility purposes.
Others	Hover-boards, electric skateboards	no			Not allowed in public spaces in Germany, excluded from eKfV.
	Personal Light Electric Vehicles (PLEV)	no	< 20 km/h	500 W	Defined by eKfV: Users need to be at least 14 years old, no driving licence is needed, but insurance is compulsory. Need a handlebar.

**Table 1:** Overview of Classification and Regulations of Micro Electric Vehicles in Germany.

L7e.<sup>4</sup> Regarding SLEV, this law regulates the power (in kW), speed (in km/h) and weight limits (in kg). With regard to FLEV, it regulates the power and weight limits. On the national level, the German Federal Ministry of Transport and Digital Infrastructure (BMVI) developed additional laws, for instance, to ensure the safety of transport, such as regulations for users to have insurances, driving licenses or adherence to a minimum age for driving vehicles.<sup>5</sup>

### 2.1.1 Non-standardised PLEV

Starting this overview from the smallest vehicles, PLEV as the electric counterparts of non-regulated micro vehicles such as inline skates, skateboards or scooters are in German referred to as “Elektrische Kleinstfahrzeuge” (eKF).

For more than five years, German authorities had a comparatively conservative stance on PLEV. Dissimilar to neighbouring countries like the Netherlands or cities like Paris or Copenhagen, which are at the forefront of redistributing urban spaces and shifting the modal split away from the automobile, it took a long time until the fast-growing worldwide trend of PLEV was convincing enough to have German authorities regulate and therefore allow them.

4 Official Journal of the European Union. (2013, March 2). Regulation (EU) No 168/2013 of the European Parliament and the Council of 15 January 2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles. Brussels.

5 Bundesministerium für Verkehr und digitale Infrastruktur. (undated). Übersicht über die Fahrerlaubnisklassen. Retrieved from: <https://www.bmvi.de/SharedDocs/DE/Artikel/StV/Strassenverkehr/fahrerlaubnisklassen-uebersicht.html>.

This lack of permitting registration of PLEV formed the biggest barrier to market growth in Germany. Sold vehicles were not permitted to be used on public roads, as it is not permitted to drive vehicles which are not covered by regulations. For instance, electric kick scooter companies in Germany had to wait for permitting legislature to launch their operations. This traditionally long regulation process has been further decelerated by German public opinion being informed by various safety concerns, propagated by organisations such as the German Cyclist’s Association and the German Insurance Industry Association, but also concerns from many municipalities. Here, municipalities feared the impact of free floating electric micro vehicle fleets, due to negative experiences following a boom in low-quality free-floating bikes.<sup>6</sup>

Several European countries mapped out individual strategies for the registration and usage of PLEV and issued national regulations without any additional need for licensing, insurance or else; others opted for stricter national regulations. This situation makes overarching European legislature on PLEV unlikely. On a national level, Germany could have followed the implementation scheme of Dutch legislators, who drafted a law in 2014 categorising PLEV as motorcycles. Therefore, PLEV in the Netherlands now need to adhere to EU standards

6 Steinau, M. (2018, July 12). 100 Euro und Fahrverbote: Wie die Leihrad-Anarchie durch Sanktionen gebrochen werden soll. Retrieved via Business Insider: <https://www.businessinsider.de/wirtschaft/100-euro-und-fahrverbote-wie-die-leihrad-anarchie-durch-sanktionen-gebrochen-werden-soll-2018-7/>.



(falling into the L1 category as mopeds), while users must be at least 16 years old and obtain an insurance for their vehicle.

In a different stance, Germany implemented a new vehicle class to specifically address PLEV. Since June 2019, they are regulated by the German regulation on electric micro vehicles “Elektrische Kleinstfahrzeuge-Verordnung” (eKFV). Vehicles which are classified according to the eKFV need to be fully motorised with a power limit of 500 W, be equipped with handlebars, have a speed limit of 6 to 20 km/h, need to be lighter than 55 kg and users need to be at least 12 years old for vehicles with maximum speed of 12 km/h, or 14 years old for vehicles with speed limit of 20 km/h.<sup>7</sup>

Hence, the German law prohibits the usage of e-boards, also referred to as hoverboards, on public roads. Meanwhile, selfbalancing boards



**Figure 1:** Example of an Electric Scooter as Regulated by the eKFV.

<sup>7</sup> eKFV. (2019, June 6). Verordnung über die Teilnahme von Elektrokleinstfahrzeugen am Straßenverkehr. Elektrokleinstfahrzeuge-Verordnung - eKFV.

with a handlebar, such as the already existing Segway, are permitted and regulated under the eKFV. Thus, the eKFV works as a holistic solution, which fundamentally defines which PLEV are allowed on public roads in Germany and how they are to be registered and used.

### 2.1.2. Two-wheeled Electric Vehicles

The group of two-wheeled vehicles includes both unclassified vehicles, notably pedelecs, and classified s-pedelecs, e-bikes and electric motorcycles. The pedelec has a special position in the German regulatory landscape: The vehicle's power limit is set at 250 W (normal rating). Despite its motor assist, which stops at 25 km/h, the pedelec always requires a mechanical operation, in other words pedalling. It can be ridden without any licenses or insurances, since it is considered a bicycle with motor-assist, but not a motorised vehicle. These circumstances make the pedelec very popular in Germany: 99.5 % of all electric bicycles sold in Germany in 2019 fall under the category of such pedelecs.<sup>8</sup>

The special status of the pedelec as a bicycle according to the German Road Traffic Registration Ordinance (StVZO) allows its use of cycle path infrastructures.<sup>9</sup> In addition, it grants special rights to cyclists in many places, such as

<sup>8</sup> ZIV. (2019, March 21). Pressemitteilungen. Retrieved from: [https://www.ziv-zweirad.de/fileadmin/redakteure/Downloads/Marktdaten/PM\\_2019\\_21.03.\\_E-Bike-Markt\\_2018.pdf](https://www.ziv-zweirad.de/fileadmin/redakteure/Downloads/Marktdaten/PM_2019_21.03._E-Bike-Markt_2018.pdf).

<sup>9</sup> StVZO. (2019, November 26). Straßenverkehrs-Zulassungs-Ordnung §§ 63a und 32.



**Figure 2:** Example of a Pedelec, the most Popular Electric Two-wheeled Vehicle in Germany.

riding on one-way streets against the direction of travel. As a result, the pedelec has become increasingly interesting not only for private use but also as a sustainable technology for the commercial transport of goods and people. The rapidly growing range of pedelec cargo bikes and pedelec bicycle rickshaws as well as numerous pilot projects and public funding measures are complementing this trend.

However, regulations for bicycles stipulated by the StVZO do not fit with commercially usable pedelec cargo bikes and pedelec bicycle rickshaws. Notably, according to StVZO § 63 a and § 32, pedelec cargo bikes are permitted a maximum length of 4.00 m with a maximum height of 2.50 m and a maximum width of 2.00 m for two-lane vehicles. There is no regulation regarding the permissible total weight, but trailer operation is permitted. Although the electric cargo bike can also – similar to a normal pedelec – operate at 250 W continuous rated power, the peak power of its pedelec auxiliary

drive is not limited. Real installed peak power ratings of electric cargo bikes, in compliance with EU Regulation 168/2013, are thus sometimes in the four-digit watt range, which physically contradicts the StVZO regulations for the permitted 250 W auxiliary electric motor drive of common pedelecs.<sup>10, 11</sup>

Consequently, there is an evident need for the further regulation of commercially usable pedelec cargo bikes and pedelec bicycle rickshaws, as the permissible dimensions and also a permissible gross weight should be aligned with the regulations for cycle path infrastructure, and the permissible rated continuous power would have to be increased as a function of the gross weight.<sup>12</sup>

Other two-wheeled vehicles that do not fall under the special status of pedelecs are classified, require a driving license and insurance, and are subject to mandatory helmet use. With a few regional exceptions,<sup>13</sup> the special rights of a cyclist, such as the use of cycle paths or riding on one-way streets against the direction of travel, no longer apply. For example, there is the speed pedelec (s-pedelec), which reaches 45 km/h

10 European Parliament (2013, 15 January). Regulation (EU) No 168/2013 of the European Parliament and of the Council of 15 January 2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles.

11 Bogdanski, R. (2019). Nachhaltige Stadtlogistik. Warum das Lastenfahrrad die letzte Meile gewinnt. München.

12 § 2 Sentence 18 VwV-StVO. (2001). Allgemeine Verwaltungsvorschrift zur Straßenverkehrs-Ordnung (VwV-StVO) From 26 January 2001\* Version of 22 May 2017 (BAnz AT 29.05.2017 B8).

13 As one exception, Baden-Württemberg in Southern Germany grants specific rights to s-pedelecs on cycling lanes. See Eurobike. (2020, June 25). S-Pedelecs – Ab auf den Radweg? Retrieved from: <https://www.eurobike.com/de/themen/urban-mobility/s-pedelecs-ab-auf-den-radweg/>.

and may have up to 500 W of rated continuous power.<sup>14</sup> With this motorisation, the s-pedelec falls into the category of L1e-B of the European classification of vehicles, which requires an AM driving license and compulsory insurance, but no regular technical inspection.

Besides the L1e-B class, the L1e-A class constitutes a special class with bicycles designed for pedal propulsion and is equipped with an auxiliary drive whose main purpose is to assist the pedal function. The power of the auxiliary drive is interrupted when the vehicle reaches a speed of 25 km/h, with a maximum rated continuous power of 1,000 W. This definition is similar to the unclassified pedelec, but the classification eliminates some benefits enjoyed by cyclists. The L1e-A class also requires an AM driving license and is subject to compulsory insurance and helmet. Therefore, there is no significant supply on the market for this vehicle class.<sup>15</sup>

Faster two-wheeled electric vehicles with a maximum speed above 45 km/h include the e-motorcycle (L3e) and the e-motorcycle with sidecar (L4e). These vehicle classes require a class A1, A or B driver's license, are subject to registration and require a main technical inspection, usually every other year.<sup>16</sup>

Interestingly, the BMVI announced Regulator

on B196 in late 2019, which makes using small electric e-mopeds (L3e-A1) much easier and more convenient, in an effort to push electric small motorcycles. A license is not needed: just a few hours of instructions, being older than 25 years and the possession of a B class driver license for more than five years are sufficient.<sup>17</sup> Clearly, the German authorities try to apply the same strategy as with the pedelec: making it as convenient as possible to buy and use to boost its popularity.

### 2.1.3. Three-wheeled Electric Vehicles

Three-wheeled vehicles in Germany predominantly fall under the L2e class, notably encompassing three-wheeled mopeds with a maximum speed of 45 km/h and up to 4,000 W of electric propulsion power, equipped with no more than two seats, including the driver's seat. There are two subclasses: The L2e-P (three-wheeled moped designed to carry passengers) and L2e-U (three-wheeled moped designed to carry goods). The faster three-wheeled vehicles belonging to class L5e, so-called powered tricycles, have similar requirements as their two-wheeled counterparts, notably a class A1, A or B driving license and mandatory registration as well as regular technical inspections. Although tricycles in use for delivering goods and packages are still

14 eKFV. (2019). Verordnung über die Teilnahme von Elektrokleinfahrzeugen am Straßenverkehr.

15 Honsel, G. (2019, July 18). Die Phantom-Pedelecs der EU. Retrieved via Heise Online: <https://www.heise.de/tr/blog/artikel/Die-Phantom-Pedelecs-der-EU-4473205.html>.

16 Honsel. (2019). Die Phantom-Pedelecs der EU.

17 BMVI. (2019, December 31). Wir erleichtern den Zugang zum Roller fahren. Retrieved from: <https://www.bmvi.de/SharedDocs/DE/Artikel/StV/Strassenverkehr/wir-erleichtern-den-Zugang-zum-Fuehrerschein-zum-a1.html>.



not very wide-spread in Germany, pilot projects across the country have been started: first products vary between 300 and 350 kg weight.

#### 2.1.4. Four-wheeled Electric Vehicles

The last vehicle class and most similar to automobiles comprises the Neighbourhood Vehicles (NBV), colloquially called quads or mini cars (four-wheeled). This category covers vehicles for multiple purposes, such as golf caddies or micro logistics vehicles. The L6e class includes four-wheeled light quadricycles with an unladen weight of up to 425 kg (excluding the mass of the batteries) and a maximum speed of 45 km/h (SLEV). The maximum continuous rated power is up to 4,000 W in the L6e-A sub-class (quad) and up to 6,000 W in the L6e-BU and L6e-BP sub-classes (freight and passenger transport, respectively). These vehicles must meet the technical requirements for three-wheeled mopeds in class L2e.

Class L6e vehicles require an AM class driving license and are subject to compulsory insurance but are not subject to registration. This means that the regular technical main inspection is not required.<sup>18</sup>

The L7e class does not have a speed limit. It includes heavier quadricycles, which no longer fall under the L6e class, with an unladen

weight of up to 550 kg (without the mass of the batteries) and a maximum useful power of up to 15,000 W at a maximum speed of more than 45 km/h (FLEV). However, vehicles in class L7e are already considered four-wheeled motorised vehicles and must meet the technical requirements for three-wheeled motorised vehicles in class L5e.<sup>19</sup> On public roads, these vehicles are classified as standard passenger cars. The L7e vehicle class requires a class B driver's license, is subject to registration and requires a main technical inspection, usually every other year.



**Figure 3:** The Citroën Ami as an Example of a Four-wheeled LEV.

## 2.2 Vehicle Classification in China

The Chinese micromobility industry has undergone an unrestricted, rapid development in the last decade, leaving the process of production, sales and usage of a number of SLEV, specifically three- and four-wheeled vehicles, in a grey

<sup>18</sup> §3 Verordnung über die Zulassung von Fahrzeugen zum Straßenverkehr (FVZ). (2011).

<sup>19</sup> eKFV. (2019). Verordnung über die Teilnahme von Elektrokleinfahrzeugen am Straßenverkehr.

China				
	Regulatory Name	Regulation	Speed/Weight	Requirements
Two-wheeled	E-bike	GB 17761-2018	< 25 km/h, max. 55 kg	Needs number plate. No driving licence or compulsory insurance needed. Driven on bicycle track.
	E-mopeds	GB/T24158-2018; GB 24155-2020	< 50 km/h, 40 - 400 kg	Need motorcycle number plate, F driving license and compulsory insurance. Must be driven on vehicle track.
	E-motorcycle	GB/T24158-2018; GB24155-2020	> 50 km/h	Need number plate, E driving licence and compulsory insurance. Must be driven on vehicle track.
Three-wheeled	E-tricycle for express service	YZ-T/0136-2014	< 15 km/h, max. 300 kg (light version, load < 150 kg) and 350 kg (heavy version, load < 200 kg)	No national standards as regards mandatory number plate, driving licence and insurance. Industrial standards apply (with logo "快递").
	E-tricycle for heavy load capacity		< 35 km/h, max. load 300 kg	No national standards as regards mandatory number plate, driving licence and insurance. Number plate only available for products listed in MIIT catalog. Local management prevails.
Four-wheeled	Four-wheel electric vehicle		< 50 km/h	No national standards as regards mandatory number plate, driving licence and insurance. Local management prevails.
Others	Mini-Electric Vehicles			No national standards yet. Local management prevails.

**Table 2:** Overview of Classification and Regulations of Micro Electric Vehicles in China.

area for a long time. Contrary to the rapidly increasing size of the micromobility market in China, the implementation of comprehensive regulations and industry standards on a national level to classify SLEV from the national government has not yet succeeded. The administrative authority for the production of motor vehicles lies with the national Ministry of Industry and Information Technology (MIIT), while for non-motorised vehicles it lies with different Chinese ministries and local governments.<sup>20</sup>

Since 2007, the ambiguous positioning of small

electric vehicles in the Chinese traffic laws has resulted in regulatory loopholes which affect law enforcement. For instance, determining accountability by traffic police after an accident between a car and an e-scooter cannot be based on any specific law. This unregulated road traffic results in high accident rates: according to the Ministry of Public Security (MPS), China has seen 830,000 traffic accidents caused by SLEV between 2012 and 2017. One reason for this might be that users rarely register their newly bought vehicles and barely attend trainings.<sup>21</sup>

20 Sustainable Transport. (2018, April 18). Electric 3-wheelers in urban delivery in China and Germany – a bumpy road ahead? Retrieved from: <https://transition-china.org/mobilityposts/electric-3-wheelers-in-urban-delivery-in-china-and-germany-a-bumpy-road-ahead/>.

21 Ou, S. (2017). A Study of China's Explosive Growth in the Plug-in Electric Vehicle Market. Oak Ridge: OAK RIDGE NATIONAL LABORATORY. Retrieved from: <https://info.ornl.gov/sites/publications/Files/Pub72210.pdf>.

Acknowledging the danger and potential of new SLEV, while realising that there is no national regulation yet, the initial strategy of the government was to encourage the provincial industrial associations to define and build their own standards for production, development and selling first. Furthermore, the municipalities, following up on the additional assigned responsibility, took action into their own hands to address the situation of SLEV flooding their streets. While some cities benefited from the advantages and convenience of SLEV on their roads in past years, others limited the road use of SLEV strictly and even banned the use of PLEV on public roads. For example, since 2013 Shenzhen strictly managed the use of SLEV and PLEV on public roads with high punishment and detailed administrative rules<sup>22</sup>. Following this, Shanghai announced its Non-motorized Vehicle Regulations to clearly ban the road use of e-scooters in 2014<sup>23</sup>, before Beijing also took similar action in 2018 to prohibit the road use of e-scooters and electric balance cars, the illegal use of which will incur a fine of 200 RMB for each violation with the police also detaining the illegal vehicles<sup>24</sup>.

Following these unchecked individual decisions of provinces, the government gradually started implementing regulations on the national



**Figure 4:** Example of Hoverboard in Use.  
Permitted Usage Varies between Chinese Provinces.

level. Since April 2019, the Chinese government launched regulations on two-wheeled electric vehicles (e-bikes, e-mopeds, e-motorcycles), finally setting rules and standards at the national legislative level. Bicycles have also become subject of many new provincial or municipal regulations, which are expected to decrease the rapid market growth of these vehicles.<sup>25</sup> Interestingly, the Chinese Government does not weigh in the factor of power limit as the German authorities do, and only regulates by the speed limit.

## 2.2.1 Non-standardised PLEV

PLEV have an extraordinarily hard stand in China, and there is still no national standard

22 Shenzhen Road Traffic Safety Management Regulations. Retrieved from: [http://www.sz.gov.cn/zfgb/2020/gb1177/content/post\\_8313043.html](http://www.sz.gov.cn/zfgb/2020/gb1177/content/post_8313043.html).

23 Shanghai Non-Motorized Vehicle Regulations. Retrieved from: [http://www.shanghai.gov.cn/nw31729/20200820/0001-31729\\_37497.html](http://www.shanghai.gov.cn/nw31729/20200820/0001-31729_37497.html).

24 Measures for the Implementation of the Road Traffic Safety Law in Beijing. Retrieved from: [http://www.beijing.gov.cn/zhengce/zhengcefa-gui/202005/t20200518\\_1899681.html](http://www.beijing.gov.cn/zhengce/zhengcefa-gui/202005/t20200518_1899681.html).

25 Report Linker. (2019). China Low-speed Electric Vehicle (SLEV) Industry Report, 2019-2025. Retrieved from: [https://www.reportlinker.com/p04968940/China-Low-speed-Electric-Vehicle-SLEV-Industry-Report.html?utm\\_source=PRN](https://www.reportlinker.com/p04968940/China-Low-speed-Electric-Vehicle-SLEV-Industry-Report.html?utm_source=PRN).



regulating these e-scooters, e-balance-bikes or e-hover-boards. Here, we can see provinces take matters into their own hand: some provinces regulated and allowed PLEV, others like Beijing have defined them as illegal transportation vehicle (only for leisure, not on public roads). If one can be found using it on the street, one must pay RMB 200 (EUR 25); since 2016 in Shanghai, the usage of non-regulated PLEV may result in a fine of RMB 50 and the vehicle will be confiscated.<sup>26</sup>

In fact, there is a perception that the safety of non-standardised vehicles is different from that of e-bikes, which use pedal riding and on average have better brakes. On the contrary, electric scooters and e-balance-bikes like Segway are perceived to be less safe and to have insufficient braking functions. They are therefore categorised as “entertainment tools”, not transportation vehicles. The management of such non-standardised vehicles in China is differently clarified in provincial and city level traffic management bureaus.

## 2.2.2 Two-wheeled Electric Vehicles

Since April 2019, with an amended version of a technical standard from MIIT, e-bikes, e-mopeds and e-motorcycles in China are

finally classified as distinct groups of vehicles.

Chinese e-bikes are, as the equivalent pedelecs in Germany, seen as non-motorised vehicles with a built-in speed limit of 25 km/h and can be driven without a driving license, helmet or insurance. They are also subject to a speed limit of 15 km/h when driving on bicycle lanes.

The Chinese e-moped can be compared to the German classification of s-pedelecs, which contrary to Germany, are very widespread in China. Chinese e-mopeds are seen as motorised vehicles with a speed limit of 50 km/h (in Germany 45 km/h) and – as the German pendant – require number plates, driving licenses (license F) and insurances. They are driven on public roads.



**Figure 5:** Examples of E-Bikes (White Licence Plate is Permanent, Orange License Plate is Temporary).

<sup>26</sup> Government of the People's Republic of China. (2019, October 14). Beijing Shi shishe ,Zhonghuarenmin-gongheguo daolu jiaotong anquanfa' banfa. Retrieved from: [http://www.gov.cn/fuwu/2019-10/14/content\\_5439471.htm](http://www.gov.cn/fuwu/2019-10/14/content_5439471.htm).

The Chinese e-motorcycle is comparable to the German e-motorcycle and defined as a motorised vehicle. They are allowed to drive faster than 50 km/h (in Germany 45 km/h) on public roads. Also, insurance, driving license (license E) and a number plate are required. Overall, the Chinese regulation on electric two-wheeled vehicles is thus relatively similar to the German counterpart (which also includes sidecars).

### 2.2.3 Three-wheeled Electric Vehicles

One example for the difficult regulation development process of SLEV are the Chinese e-tricycles, which are used extensively for delivering goods or packages.

Regulations for electric tricycles are referred to in the National Standard No. 7258. Electric tricycles are defined as motorised vehicles like their conventional counterparts. According to the national standard, they are categorised based on their weight, speed limit, the position of the third wheel and the driving cab being closed or open. In total, there are five categories of vehicles defined in the Standard No. 7258 (Technical specifications for safety of power-driven vehicles operating on roads), which are very similar compared with the German standards from L1e to L5e, although there are no L6e to L7e in China. Categories 2, 4 and 5 are relevant to tricycles, with speed less

than 50 km/h as “light tricycles”, higher than 50 km/h as “normal tricycles” and with a side seat as “side tricycles”.

As transportation tools for the logistics industry, there are already specific industrial standards for postal tricycles. Meanwhile, it is unlikely that new national regulations will be introduced within the next two years, given that it takes at least four to five years for a central government order to be implemented by provincial governments.

Since e-tricycles are defined as motorised vehicles, they need to be registered and the driver needs to obtain a driving license and insurance. Given further obstacles to their acquisition in terms of their size and costs, the potential market for personal use of e-tricycles is hence rather limited in China.

Nevertheless, there is huge potential for the commercial market with e-tricycles for the lo-



**Figure 6:** Example of a Chinese E-Tricycle for Logistics Purposes.

gistic or delivery industry, mainly because of their load capacity, smaller size and lower costs compared to conventional vehicles. Unlike for the individual use of e-tricycles, since 2014 the logistics industry implemented their own standard YZ/T 0136-2014, which defined the dimension, weight, speed, and battery standards.

As of now, e-tricycles for express service (identification by the Chinese Express logo “快递”) are subject to a speed limit of 15 km/h when driving on bicycle lanes. Despite the speed limit, they can not be classified as non-motorised vehicles, due to their non-compliance with other technical requirements of non-motorised vehicles. They are also mostly driven without a nationally regulated number plate, driving licenses or insurance. The weight varies between 300 and 350 kg (similar to Germany) and the load lies between 150 and 200 kg.

E-tricycles for heavy load capacities can load twice that weight (300 kg) and drive up to 35 km/h. In the manufacturing process, their dimension, weight, speed, and battery standards have to conform the national technical guideline for conventional tricycles (GB/T 24945-2010). As regards driver requirements and road regulation, there is no unified national regulation, so that each province follows their own regulations. Number plates are only available for MIIT-approved tricycles and are managed by individual provinces. If a driving license is required, it falls under C4 or upper categories.

The need for driving licenses or insurances even varies between provinces depending on the categorisation of certain vehicle types as non-motorised or motorised. Municipalities like Shenzhen have already settled on a transition time for regulation and upgrading illegal e-tricycles and additionally introduced policies to manage e-tricycles in the future. The capital city Beijing announced the strictest regulation to forbid illegal electric three-wheeled and four-wheeled vehicles in July 2021, setting a clear deadline for delisting illegal electric three-wheeled and four-wheeled vehicles by the end of 2023.<sup>27</sup> After this transition period, electric three-wheeled and four-wheeled vehicles will be managed as their conventional counterparts, so that number plates, driving licenses and insurances will be mandatory. Yet, there are still not very clear regulations in place for e-tricycles at the national level. It thus remains a long way to go to unify this vehicle class in China, considering both private use, logistic e-tricycles and heavy-load e-tricycles.

## 2.2.4 Four-wheeled Electric Vehicles

In China, there have long been debates as to whether four-wheeled SLEV belong to the normal passenger car category or whether they should be listed as a new sub-category

<sup>27</sup> The People's Government of Beijing Municipality "Notice on Strengthening the Management of Illegal Electric Three-Four Wheelers". Retrieved from: [http://www.beijing.gov.cn/zhengce/gfxwj/202107/t20210712\\_2434569.html](http://www.beijing.gov.cn/zhengce/gfxwj/202107/t20210712_2434569.html).

of normal passenger cars. Due to the lack of technical standards and missing management regulations, four-wheeled SLEV were thus considered as a “mystic specie” running in the grey zones, where neither legal authorities like traffic policemen nor users and manufacturers were able to explain their vehicle status. Finally, in 2020 the leading ministry MIIT started to amend the existing technical guideline GB/T 28382 “Battery electric passenger cars – Specifications,” whose final version is expected at the end of 2021. In its current draft version, four-wheeled electric vehicles (defined as motorised vehicles) are classified and regulated as a sub-category under normal passenger cars with a speed limit of max. 70 km/h and other technical requirements like max. 4 seats, 3D-dimension within 3.5 m x 1.5 m x 1.7 m, total weight less than 750 kg, and total reach of more than 100 km. Number plate, driver licenses and insurances should also be regulated as for normal passenger cars, but different stances between provinces and cities prevail.

During the last decades, China already realised the complexity and risks associated with illegal electric four-wheeled vehicles, and consequently started tightening the regulations for various illegal vehicles since 2018. Even though there are still no national level management regulations yet, this increased monitoring shows a clear signal that controls and management are expected to be tighter than ever.



**Figure 7:** Example of a Four-wheeled LEV in China.

## 2.3 Comparative Perspective: Technical Standards and Regulatory Developments

In Germany, unclassified SLEV, notably PLEV and electric pedelecs, have a variety of privileges when using public roads: They do not require a driving license or registration and are not subject to helmet requirements. The German Electro Mobility Law (EmoG), in force since June 2015, has further created incentives for free parking spaces for electric micro vehicles and ensured their usage on public cycling infrastructures.<sup>28</sup> The acquisition and operational use are thus relatively accessible, which explains their market success.

While China was named the “bicycles kingdom” in previous decades, the mode of daily

28 Harendt, B. et al. (2018). Elektromobilitätsgesetz (EmoG). Bericht-erstattung 2018. Retrieved from: [https://www.bmvi.de/SharedDocs/DE/Anlage/G/elektromobilitaetsgesetz-berichterstattung-2018.pdf?\\_\\_blob=publicationFile](https://www.bmvi.de/SharedDocs/DE/Anlage/G/elektromobilitaetsgesetz-berichterstattung-2018.pdf?__blob=publicationFile).



travel in Chinese cities changed significantly during the economic boom of the 1990s. Similar to Germany, unclassified SLEV, PLEV like e-bikes/mopeds, e-scooters and e-hoverboards, and three-/four-wheeled e-vehicles benefited from generous privileges due to the lack of laws and regulation. Yet, the situation has drastically changed over the course of the last five years. In light of too many unclear accidents and negative risk when interacting with legal public transportation facilities and infrastructures, the Chinese government is now tightening the regulation and shows clear signals that unclassified PLEV, SLEV and FLEV will face strong difficulties to survive in the near future. All apparent advantages, such as the non-existing requirements for driver's licenses, number plates or compulsory traffic insurance turn into disadvantages, as they are defined as illegal transportation vehicles or will be classified as motorised vehicles as their conventional counterparts, resulting in more controls when being used on public roads.

Classified SLEV and FLEV in Germany are not provided with the privileges of their PLEV counterparts, with major differences between SLEV and FLEV. Generally speaking, the L classification imposes largely simplified technical construction regulations on manufacturers compared to a conventional motorised vehicle. For example, common safety standards such as the Antilock Brake System (ABS), the Electronic Stability Programme (ESP) or airbags

are not required to be installed for licensing which leads to relatively low manufacturing costs. SLEV in particular are attractive since users can easily obtain an AM driving license at the age of 16 and do not have to subject their SLEV to regular technical inspections.<sup>29</sup>

Nevertheless, the speed limit of 45 km/h for SLEV hampers a widespread implementation, particularly of light four-wheeled electric vehicles as alternatives to standard passenger cars, since it does not allow these vehicles to flow in inner city congestion streams. Moreover, this category is unattractive for private and commercial utilization in an urban setting for several reasons: Obtaining a class B driver's license for FLEV is complex and can only be acquired at the age of 18. In addition, the regular main technical inspection is required and the transport capacity reduced – exacerbated by the power limit. Besides, both classified categories, SLEV and FLEV, do not enjoy any privileges in the use of public space for driving and parking. As a case in point, experts see the prohibition of s-pedelecs to cycle on cycling lanes as a major obstacle to their increased consumer uptake.<sup>30</sup>

Although in China, the question of how to classify (non-motorised or motorised) SLEV and PLEV remained unclear in the past, the

29 BMVI. (undated). Übersicht über die Fahrerlaubnisklassen.

30 Knese, Dennis. (2019). Integration der Elektromobilität in die Stadtplanung und Straßenraumgestaltung – Lösungsansätze für Strategien, Konzepte und Maßnahmen. Dissertation, Universität Kassel. Retrieved from: <https://www.uni-kassel.de/ub/publizieren/kassel-university-press/verlagsprogramm?h=9783737606929>.

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continually standardised technical regulation and management guidelines will likely solve the problem in the coming years. Looking ahead, classified e-bikes could provide a suitable solution for the urban transport and delivery sector with a range of around 10 to 15 km for private use. They might further be especially useful in regions with hilly landscapes and difficult topographical conditions. Prospectively, with new standards of e-tricycles, the logistics or healthcare sector will offer new growth potential in the near future, too. Electric four-wheeled vehicles will be defined individually as a sub-category of the category of battery electric vehicles (BEV), at the same time as financial subsidies provided by the central or local government to manufacturers of small class electric vehicles almost squeeze the cost gap to illegal four-wheeled vehicles. In addition, tighter control, higher traffic violation fines and common safety standards such as ABS, ESP or airbags, which will make light electric vehicles safer for passengers, will hinder the development of FLEV in China.

A predictable urban transportation vehicle structure in China in the near future will be based on balanced cost-time efficiency, usage-convenient and environment-friendly means of transport and safety conditions. The latter will most likely be built on classified motorised vehicles with higher percentage of electric vehicles, combined with public transportation for longer distance and shorter

distance with classified (non-motorised) e-bikes. Three-wheelers will only be focused on as duty, not as passenger vehicles. The category between a legal e-bike and a normal vehicle will be supplemented with a new sub-category of “low speed battery electric passenger car” with a speed limit of 70 km/h and max. 4 seats. This category could be attractive in the future if more advantageous managerial regulation could be achieved, for example, measures such as a special class driving license, a new type of mandatory traffic insurance, or road separation regulations between a new sub-category and conventional motorised vehicles. Regular technical inspection and special zones in inner cities with entry limits and caps for large-size vehicles for reducing traffic congestions could pave the way to develop this new category of “low speed battery electric passenger car”.

According to different consulting agencies, the global market for micromobility could reach a volume of EUR 255 billion to EUR 770 billion by 2030 (USD 300-900 billion).<sup>31</sup> Comparing the market situation for SLEV in Germany and China, one trend is astounding: the quick and continuing rise of e-bikes, including pedelecs, s-pedelecs and electric mopeds, in both countries, and the widespread implementation of e-tricycles in China for the logistics sector.

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31 Eggert, A., & Tillemann, L. (2019). Is American Micromobility a Bust? Opinion: China's e-biking masses offer a model for our struggling scoot-scape. Retrieved from: <https://www.wired.com/story/is-micromobility-a-bust/>.

## 3 Market Analysis

### 3.1 Germany

The German electric vehicle market is currently mainly shaped by electric car sales and unclassified pedelecs. Other vehicles in the spectrum of PLEV, SLEV and FLEV record varying demands and growth potentials. NBV, as in China, make up a very small market share. For instance, the SLEV Renault Twizy has seen a total number of about 4,800 vehicle permissions on public roads between 2012 and 2018. By comparison, the electric passenger car Renault Zoe sold over 30,000 vehicles in 2020 alone.<sup>32</sup> This clear difference between the electric car markets might be explained by the fact that state subsidy for electric mobility in Germany is still mainly offered for electric passenger vehicles, and therefore not including smaller electric vehicle types.

Meanwhile, the quick rise in popularity of e-bikes has exceeded most expectations. 1.95 million electric bicycles were sold in Germany in 2020, corresponding to a 43 % year-on-year increase.<sup>33</sup> Figure 8 depicts the quick increase of the e-bike market share in the bicycle market, estimating a 50 % market share in the long term. Here it must be pointed out that

this graphic does not include e-motorcycles, as these are considered an inherently different vehicle type.<sup>34</sup> Over 90.0 % of the e-bikes are indeed pedelecs.<sup>35</sup> In 2020, every sixth German (15.6 %) owned a pedelec.<sup>36</sup> This popularity can be explained by the comfortable conditions of this vehicle: no insurance or license is needed, and no helmet must be worn. Additionally, a wealthy and aging middle class and an increasing consciousness for environmental and health-related factors combined with the described low entry barriers bolster pedelec sales.

Although the share of pedelec cargo bike sales on the two-wheeled vehicle market is still comparatively small, it should be highlighted that over 75 % of 100,000 cargo bikes sold in 2020 were electric vehicles.<sup>37</sup> To make pedelec cargo bikes even more attractive as a sustainable transport technology for commercial use, the legal framework of the StVZO needs to improve in line with the cycle path infrastructure (see Chapter 2.1.2). Funding measures must target both municipal regulations to reorganise urban spaces, as well as private commitment of firms to invest in the acquisition of cargo bikes and establish new logistical con-

32 Leichsenring, Stefan (2021, 11 January). Meistverkaufte Elektroautos im Jahr 2020: Ueberraschung auf Platz zwei. Retrieved from: <https://de.motor1.com/news/465424/meistverkauften-elektroautos-im-jahr-2020/>

33 Zweirad-Industrie-Verband. (2021, 10 March). Press Conference on Bicycle Market in Germany 2020. Retrieved from: [https://www.ziv-zweirad.de/fileadmin/redakteure/Downloads/Marktdaten/PM\\_2021\\_10.03\\_ZIV-Praesentation\\_10.03.2021\\_mit\\_Text.pdf](https://www.ziv-zweirad.de/fileadmin/redakteure/Downloads/Marktdaten/PM_2021_10.03_ZIV-Praesentation_10.03.2021_mit_Text.pdf).

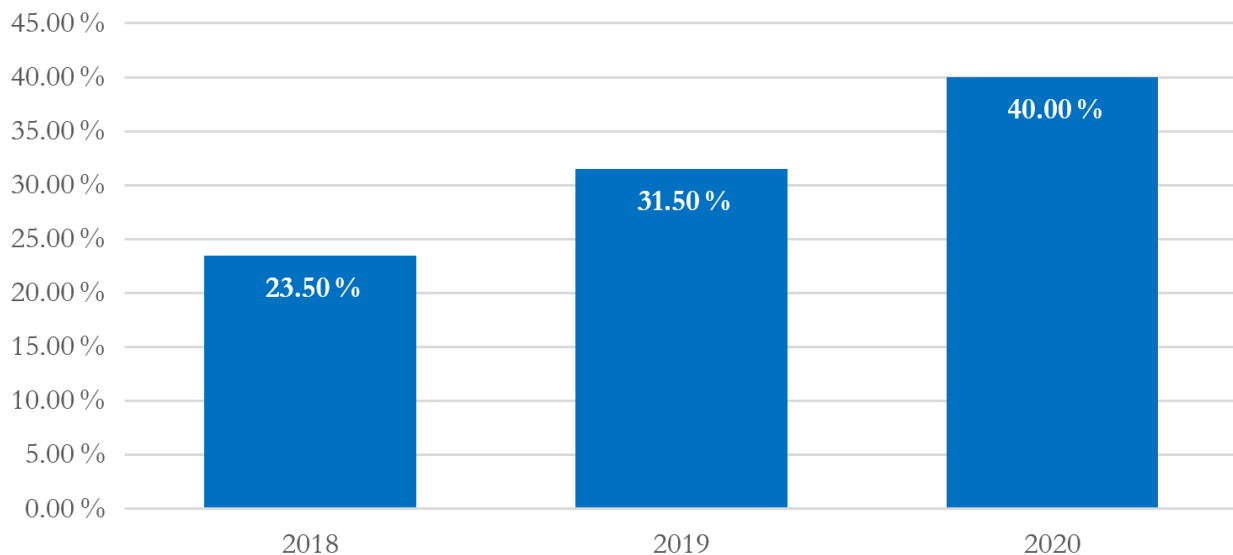
34 Statista. (2020). Absatz von Lastenrädern in Europa bis 2020. Retrieved from: <https://de.statista.com/statistik/daten/studie/1166113/umfrage/absatz-von-lastenraedern-in-europa/>

35 ADFC (no date). Pedelecs und E-Bikes. Retrieved from: <https://www.adfc.de/artikel/pedelecs-und-e-bikes>

36 E.ON. (2020). E-Bikes and Pedelecs auf dem Vormarsch. Retrieved from: <https://www.eon.de/de/eonerleben/e-bikes-auf-dem-vormarsch.html>.

37 Zweirad-Industrie-Verband. (2021, March 10). Press Conference on Bicycle Market in Germany 2020.

## Annual Market Share of E-Bikes of All Bikes Sold in Germany



**Figure 8:** Annual Market Share of e-bikes of All Bikes Sold in Germany. Source: (ZIV, 2021).

cepts such as the micro-depot concepts.<sup>38</sup>

Connected to constant imports of electric pedelecs from Asia, especially low prices and the risk of illegal subsidies have raised discomfort with European policymakers and manufacturers. In August 2019, the European Commission thus signed the “Implementing Regulation 2019/73”: Based on an extensive investigation on 70 Chinese electric pedelec exporters, the regulation imposed anti-dumping duties on imports of electric pedelecs originating in China. In practice, many Chinese electric pedelec suppliers have hence been hit with punitive tariffs of about 20 to 80 %.<sup>39</sup> Following

heated debates and backlash from the European bicycle industry association, the Commission has granted certain exceptions to such tariffs in its follow-up Regulation 2020/1296 in September 2020. Critics however note that the punitive measures have missed their purpose altogether, as overseas imports merely shifted from Chinese to other Asian suppliers.<sup>40</sup>

Aside from electric pedelecs, driver’s license-free PLEV, in particular e-scooters, have only become widespread on the market in

menting Regulation EU 2019/73 of 17 January 2019. Retrieved from: [https://www.stradalex.com/en/sl\\_src\\_publ\\_leg\\_eur\\_jo/toc/leg\\_eur\\_jo\\_3\\_20200121\\_16/doc/ojeu\\_2019.016.01.0108.01](https://www.stradalex.com/en/sl_src_publ_leg_eur_jo/toc/leg_eur_jo_3_20200121_16/doc/ojeu_2019.016.01.0108.01).

40 Beckendorff, Jo. (2021, 26 January). Anti-dumping duties on e-bikes from China do not benefit EU manufacturers as expected. Outdoor Industry Compass. Retrieved from: <https://www.oicompass.com/trade-and-sourcing/anti-dumping-duties-on-e-bikes-from-china-do-not-benefit-eu-manufacturers-as-expected/86817.article>.

38 Bogdanski, R. (2019). Nachhaltige Stadtlogistik. Warum das Lastenfahrrad die letzte Meile gewinnt. München.

39 European Commission. (2019, January 17). Commission Imple-



Germany since the promulgation of the eKfV in June 2019, mainly driven by fleet providers through “free floating” and sharing offers in large cities. In the case of this vehicle category, it becomes particularly clear what influence the simplest possible legal framework conditions for usability have on a vehicle’s market penetration. The oftentimes hesitant attitude of many municipalities to grant permits to fleet providers also influences the further development of this market segment.

All other SLEV of the vehicle classes L1e, L2e and L6e hardly play any role in the German market, although only an insurance license plate and the relatively easy-to-obtain class AM driving license are required.<sup>41</sup> An important reason is certainly the impractical limitation of the maximum permitted speed to 45 km/h. Unless regulated otherwise, a maximum speed of 50 km/h applies in urban areas in Germany. This means that SLEV in these vehicle classes are perceived as traffic obstacles by other road users and are frequently overtaken, which impairs the subjectively perceived road safety of SLEV drivers. Another reason is the absence of any privileges in public space for these SLEV, which thus have to share traffic spaces for moving and stationary traffic with all other motorised vehicles. In a more stringent form, these statements also apply to

FLEV of classes L3e, L4e, L5e and L7e. The market opportunities for FLEV are further diminished by the fact that the A1, A or B driving license classes can only be acquired at a considerable expense, in combination with the registration requirement and the associated obligation to undergo an expensive technical inspection at regular intervals.

## 3.2 China

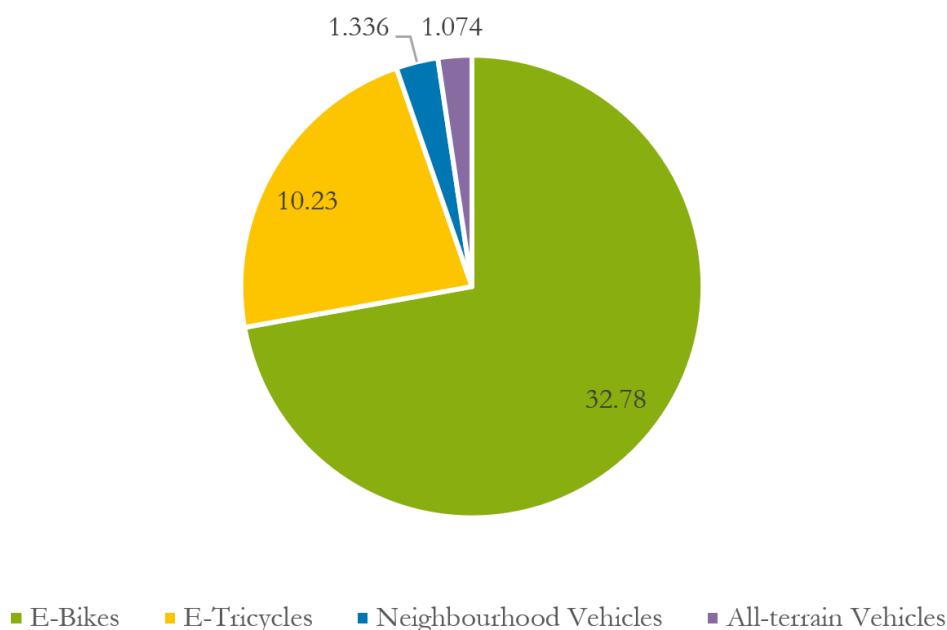
Electric vehicles have already been developed for nearly two decades, but in particular vehicles belonging to the SLEV category are clearly changing both the Chinese industry and society. For example, four-wheeled small electric vehicles are obtainable for RMB 8,000-30,000 (~ EUR 1,000-EUR 4,000), and new electric scooters can be bought for less than RMB 800 (~ EUR 100), second-hand models even cheaper. Their affordable prices make SLEV particularly attractive for low- or mid-income consumers, both in urban, sub-urban as well as rural areas in China.

Despite operational disadvantages due to the lack of safety and protection equipment, the electric micro vehicle market has been flourishing over the past ten years. Consequently, its low-margin and high-volume business attracted many manufacturing firms and private capital looking to invest<sup>42</sup>, and the way of

41 e-mobil BW. (2019). Elektrische Klein- und Leichtfahrzeuge. Chancen und Potenziale für Baden-Württemberg. Stuttgart: e-mobil Baden-Württemberg. Retrieved from: [https://www.e-mobilbw.de/fileadmin/media/e-mobilbw/Publikationen/Studien/LEV\\_e-mobil\\_BW\\_Leichtfahrzeug\\_Studie.pdf](https://www.e-mobilbw.de/fileadmin/media/e-mobilbw/Publikationen/Studien/LEV_e-mobil_BW_Leichtfahrzeug_Studie.pdf).

42 Ou. (2017). A Study of China’s Explosive Growth in the Plug-in Electric Vehicle Market.

## All Produced SLEV in China in 2018 (in Million)



**Figure 9:** The Composition of the Chinese SLEV Market in 2018. Based on: (Report Linker, 2019).

daily travel in Chinese urban and sub-urban cities and areas changed drastically. Compared to the car market, the figures are remarkable: in 2019, at least 300 million SLEV were driving on Chinese streets, equalling the number of conventional cars in China.<sup>43</sup> In addition, China's SLEV relevance for the global market is also very clear: For example, in 2018, 45 million SLEV were produced in China (3.9 % rise on annualised basis), accounting for 90 % of sold vehicles worldwide. At the same time, only 28 million cars were produced in China.<sup>44</sup>

<sup>43</sup> Eggert, A., & Tillemann, L. (2019). Is American Micromobility a Bust? Opinion: China's e-biking masses offer a model for our struggling scooter-scape.

<sup>44</sup> Report Linker. (2019). China Low-speed Electric Vehicle (SLEV) Industry Report, 2019-2025.

Figure 9 shows the composition of the Chinese SLEV market and the overwhelmingly large share of electric two-wheeled vehicles of all SLEV: 95 % of all SLEV in 2018 were e-bikes or e-tricycles. Since the announcement of a new e-bike regulation in 2018, the e-bike industry has benefited from overall modernisation and standardisation, reflected in a total market value near EUR 167 billion in 2019 and a total market volume of 300 million e-bikes on Chinese roads. The remaining margin of NBV of 5 % is further undermined, since 95 % of these are exported, illustrating very low demand for this vehicle type in China.<sup>45</sup>

<sup>45</sup> Report Linker. (2019). China Low-speed Electric Vehicle (SLEV) Industry Report, 2019-2025.

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However, the future of SLEV in China might be partially clouded, since newly imposed regulations and policies on provincial and municipal level and lacking national regulations are expected to influence and slow down their growth rate. In this regard, while the compound annual growth rate of electric two-wheeled vehicles grew 14.2 % from 2010-2018, it is expected to slow down to 6 to 9 % in 2019-2025. The same can be applied to e-tricycles: new environmental policies are expected to shrink the production output from 10 million in 2018 to 9.4 million in 2025.

The main deployment area of these three-wheeled vehicles will be in the delivery and logistics industry, driven by the vehicles capacity and relevant regulations. A widespread usage for passenger transport on public roads is considered to be unlikely.

Meanwhile, illegal four-wheeled electric vehicles are expected to face obstacles to market access due to new Chinese regulators and a consequent share of usage on public roads.

In sum, the compound annual growth rate for SLEV, amounting to at 45 % in 2018, is thus expected to decrease. Currently, Chinese companies are waiting for new implementation of technical standards or are upgrading their production to produce larger personal electric vehicles beyond the micromobility category.<sup>46</sup>

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<sup>46</sup> Report Linker. (2019). China Low-speed Electric Vehicle (SLEV) Industry Report, 2019-2025.

## 4 Conclusion and Outlook

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This article mapped out both challenges and potentials of low speed electric vehicles between the margins of going by foot and going by car, which are growing increasingly in popularity. A comparison between Germany and China stresses the lack of standardised definitions of industry terms such as SLEV, whose parameters differ according to regional and national regulations. In Germany, SLEV usually refers to electric vehicles up to 45 km/h and encompasses the groups of PLEV, e-bikes, e-motorcycles and NBV. In China, where the term SLEV has less regulatory relevance, these vehicles can exceed speeds of 70 km/h and include two-wheelers, e-tricycles and NBV. In Germany, regulation is differentiated by speed and power limit on national level, in China only technical standards for SLEV have national regulations, but leave the regulation for operation and evaluation (of motorised or non-motorised vehicles) for SLEV up to provinces and cities.

We can also identify different approaches of the two countries dealing with new vehicle groups. In China, national standards and regulations have been absent for more than a decade from SLEV production, causing low quality standards of vehicles as well as traffic and security concerns. For a long time, only provinces and municipalities implemented regulations and achieved industry standards on their own. Now, the tide has turned: During the last five years, China has increasingly been trying

to catch up with its own regulation as regards the rapid but disorderly development and production of three or four-wheeled SLEV. Additional regulations on those SLEV are thus expected to deflate the growth rate of the SLEV market, as new capacities for productions of such kind are stopped, and the market entry of new SLEV models is prohibited, whereas legal e-bikes are continuously promoted. Despite the negative impact of such increased standardisation on the market's growth rates, holistic regulations can be the groundwork for safer and more quality-driven production of SLEV.

Notwithstanding critical concerns regarding their safety, manufacturing standards and traffic infrastructure layouts, the assets of SLEV as resource-efficient, low-cost and agile vehicles turn them into important drivers of an urban transport transition. Against this background, a new discussion about last-mile vehicles can shed light on needed cooperation on this topic from Germany and China, as well as the needed additional infrastructure for charging and sharing LEV in the public space.

Currently, the considerable potential for sustainable mobility of people and goods through the use of SLEV and FLEV remains unexploited in German metropolitan areas.<sup>47</sup> To leverage their potentials, incentives must be created for potential user groups and use cases. The success of pedelecs shows that simple and

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<sup>47</sup> E-mobil BW. (2019). Elektrische Klein- und Leichtfahrzeuge. Chancen und Potenziale für Baden-Württemberg.



practical legal frameworks for their use are an important incentive, coupled with the privileges of cyclists in public space.

**Corresponding policy recommendations for German policymakers include:**

- ▶ Legal frameworks should reflect and adjust to increased pedelec usage of all types. In particular StVZO regulations regarding pedelec cargo bikes, but also s-pedelecs, should be reformed and specified. Adjusted speed limits on the respective cycling lanes may support a reorganisation of transport infrastructures.<sup>1</sup>
- ▶ For SLEV of the L1e, L2e and L6e vehicle classes, the maximum permissible speed should be raised to 50 km/h applied in urban areas to facilitate a smooth integration in inner-city traffic flows.<sup>2</sup>
- ▶ New obligations for municipalities to provide a minimum share of parking space with charging infrastructure, in combination with low-cost parking options, may thus significantly increase the acceptance of SLEV and FLEV.<sup>3</sup>
- ▶ To support the commercial use of SLEV and FLEV for freight transport, their acquisition and special logistical concepts such as the micro-depot concept should be promoted.<sup>4</sup>

1 Knese, Dennis. (2019). Integration der Elektromobilität in die Stadtplanung und Straßenraumgestaltung – Lösungsansätze für Strategien, Konzepte und Maßnahmen.

2 E-mobil BW. (2019). Elektrische Klein- und Leichtfahrzeuge. Chancen und Potenziale für Baden-Württemberg.

3 Knese, Dennis. (2019). Integration der Elektromobilität in die Stadtplanung und Straßenraumgestaltung – Lösungsansätze für Strategien, Konzepte und Maßnahmen.

4 Bogdanski, R.; Cailliau, C. (2021). Mikromobilität auf der letzten Meile.

In China, due to the unregulated development of SLEV over the last two decades, individual transportation by personal light vehicles has been associated with various problems and concerns, especially in big cities. To bring it back on track, China should not only define and develop new technical standards, but also focus on quick response of managerial measures for existing SLEV. It is good news that

in several cities, Chinese authorities have already settled clear deadlines to regulate illegal SLEV and set development targets for their legal counterparts. While this shows that national level managerial regulations especially for three and four-wheeled micro electric vehicles have not yet been realised, it could be expected that China will regulate their SLEV market more efficiently and safely in the near future.

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**Corresponding policy recommendations for Chinese policymakers include:**

- ▶ The reform of legal frameworks should speed up to increase not only technical regulations, but also managerial regulation at local level to complement existing regulations at national level.
- ▶ For e-bikes defined as non-motorised vehicles, the maximum permissible speed could be raised from 15 km/h to at least 25 km/h applied in urban areas. In combination with public transport, this mode of travel will cover most daily travel needs in urban and sub-urban areas.
- ▶ To support the commercial use of electric three-wheeled or four-wheeled vehicles for freight transport or healthcare duties, industrial standards and management measures should be promoted.
- ▶ A tighter management of the use of illegal SLEV in China should be enforced and enhanced.

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## 6 Image References

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**Figure 3** - Own image: © Quentin Radlwimmer (2021), The Citroën Ami as an Example of a Four-wheeled LEV.

**Figure 4** - Own image: © Tong Liu (2021), Example of Hoverboard in Use. Permitted Usage Varies between Chinese Provinces.

**Figure 5** - Own image: © Tong Liu (2021), Examples of E-Bikes (White Licence Plate is Permanent, Orange License Plate is Temporary).

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# 7 Annex: Overview of Vehicle Classes in Germany and China

Germany				China			
Regulatory Name	Definition	EU Classification	Speed	Power	Regulations and Requirements	Regulatory Name	Definition
Pedelec	Unclassified	no		250 W	No license, insurance or helmet needed. Allowed on bicycle track. Trailer allowed.	E-bike	Electric bicycle (SLEV)
S-pedelec	SLEV	L1e-B	Pedal assist up to 45 km/h	500 W	AM driving license, insurance and helmet needed. Not allowed on bicycle track.		
E-bike 20 (Powered cycle)	SLEV	L1e-A	Motor assist up to 20 km/h	500 W	AM driving license and helmet needed. Helmet not needed. Can be used on bicycle tracks out of town.	Emopeds	SLEV
E-bike 25 (Powered cycle)	SLEV	L1e-A	Motor assist up to 25 km/h	1,000 W	AM driving license, insurance and helmet needed.		
E-bike 45 (Two-wheeled moped)	SLEV	L1e-B	Motor assist up to 45 km/h	4,000 W	AM driving license, insurance and helmet needed. Not allowed on bicycle track.	Emotorcycle	
Two-wheeled motorcycle	FLEV	L3a/L4e for vehicles with side-car)	> 45 km/h	11,000 W	A1, A2 or A driving licence needed. Sub-categorisation according to performance levels.		
Three-wheel motorcycle	SLEV	L2e	< 45 km/h	4,000 W	AM driving licence needed. Sub-categorisation according to performance levels, passenger transport (L2e-P) or utility purposes (L2e-U). Max. weight 270 kg.	SLEV	
Powered triocycle	FLEV	L5e	> 45 km/h		A1, A or B driving licence needed.	E-tricycle for heavy load capacity	
Light quadricycles	SLEV	L6e	< 45 km/h	4,000 - 6,000 W	AM driving licence needed. Subcategorisation according to performance levels, passenger transport or utility purposes. Weight below 425 kg.		
Heavy quadricycles	FLEV	L7e	> 45 km/h	15,000 W	B driving licence needed. Subcategorisation according to performance levels, passenger transport or utility purposes. Weight between 450 - 600 kg.	Four-wheel electric vehicle	
Hover-boards, electric skateboards	Unclassified, illegal	no			Not allowed in public spaces in Germany, excluded from eKY.	Mini-Electric Vehicles	Non-standardised transport instruments, including e-scooters, segways and e-boards
Personal Light Electric Vehicles (PLEV)	SLEV	no	6 - 20 km/h (depending on vehicle)	500 W	Defined by eKY. Users need to be at least 14 years old, no driving licence is needed, but insurance is compulsory. Need a handlebar.		

Germany				China			
Regulatory Name	Definition	EU Classification	Speed	Power	Regulations and Requirements	Regulatory Name	Definition
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E-bike 25 (Powered cycle)	SLEV	L1e-A	Motor assist up to 25 km/h	1,000 W	AM driving license, insurance and helmet needed.		
E-bike 45 (Two-wheeled moped)	SLEV	L1e-B	Motor assist up to 45 km/h	4,000 W	AM driving license, insurance and helmet needed. Not allowed on bicycle track.	Emotorcycle	
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Deutsche Gesellschaft für  
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices  
Bonn und Eschborn

GIZ in China  
Sunflower Tower, Room 1100  
Maizidian St. 37, Chaoyang District  
100125 Beijing, P. R. China  
T +86 (0)10 8527 5180  
F +86 (0)10 8527 5185

E [giz-china@giz.de](mailto:giz-china@giz.de)  
I [www.giz.de](http://www.giz.de)  
I [www.transition-china.org/mobility](http://www.transition-china.org/mobility)

